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## PRELIMINARY TESTS OF SOME ESTERS OF PROPIONIC ACID

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Seventy-one esters of propionic acid were tested as insecticides in the laboratory of this Bureau, at Anaheim, Calif., from March to December 1951. These esters are represented by the general formula,

0

## C2H5-C-OR

where R is an aryl or alkyl group with or without substituents. All the compounds were prepared by reacting alcohols and phenols with propionic acid or propionic anhydride under suitable conditions. They were tested against three or four species of insects and one spider mite.

The following species were used:

Armyworm (Psuedaletia unipuncta (Haw.))
Celery leaf tier (Phlyctaenia rubigalis (Guen.))
Large milkweed bug (Oncopeltus fasciatus (Dall.))
Pea aphid (Macrosiphum pisi (Harris))
Salt-marsh caterpillar (Estigmene acrea (Drury))
Two-spotted spider mite (Tetranychus bimaculatus Harvey)

The insects were reared in the laboratory, and the two-spotted spider mites were collected in the field.

In each test that the species was used, the following number of individuals were tested: 30 larvae of the armyworm and the salt-marsh caterpillar, 24 larvae of the celery leaf tier, 20 milkweed bugs, and an average of 29 aphids and 57 mites. The test samples were either sprayed or dusted on foliage, and the foliage was placed in petri dishes with larvae of the armyworm, the celery leaf tier, and the salt-marsh caterpillar. Large milkweed bugs were placed in 8-cm. crystallizing dishes and dusted or sprayed. Untreated food and water were supplied and the dishes were covered with coarse muslin. The pea aphids were removed from an infested plant for treating, and were kept during the test period on potted Windsor bean plants in cloth-capped glass battery jars 7 inches in diameter. The two-spotted spider mites were dusted or sprayed while on castor bean leaves and were kept in battery jars.

The samples were first tested for insecticidal action. Those tested as dusts were diluted to 10 percent in pyrophyllite and were in good physical condition for dusting. Those tested as sprays or dips were diluted to 5 percent or less on a weight/volume basis in acetone or water.

Some materials causing insect mortalities of 75 percent or higher as dusts or sprays were applied as sprays to the leaves of five growing plants to determine whether they would be too injurious to green foliage for practical use against leaf-eating insects. The sprays contained 1 percent of the active ingredient and were applied to both sides of the leaves until there was run-off.

The results of tests with three insecticides of known value against certain insects, made for comparative purposes, are presented in tables 1 and 2.

Fifty-six compounds caused greater than 74 percent mortality to one or more species of insects when tested as sprays or dips, as shown in table 3. 2,4-Dinitro-6-biphenylyl, pentabromophenyl, and pentachlorophenyl propionates were the most effective acaracides, all causing over 75 percent mortality of the two-spotted spider mite when tested as 0.05-percent sprays. Against the armyworm, 2,4-dinitro-6-biphenylyl and pentachlorophenyl propionates were effective as 0.5-percent sprays, thus making these two compounds the only ones effective as low-concentration sprays against more than one specificative when used as 0.5-percent sprays against the large milkweed bug and p-bromophenyl as propionates were effective when used as 0.5-percent dips against the pea aphid.

Thirteen compounds caused greater than 74 percent mortality to one or more species of insects when tested as 10-percent dusts, as shown in table 4. Three compounds were found to be effective against the armyworm and the two-spotted spider mite. They were 2-biphenylyl, pentachlorophenyl, and 2,3,4,6-tetrachlorophenyl propionates. 6-tert-Butyl-m-tolyl propionate was also effective against the two-spotted mite. The following compounds were effective against larvae of the celery leaf tier: Dipropionates of 2,4'-di-hydroxybenzophenone, 4,4'-dihydroxybenzophenone, and 1,5-naphthalenediol, and 2-bromo-4-tert-butylphenyl, p-cyclohexylphenyl, and m-ethylphenyl propionates. One hundred percent mortalities of second-instar pea aphids resulted from the use of 2-naphthyl propionate and p-nitrophenyl propionate. The latter was also effective as a 5-percent dust. None of the compounds tested as dusts against the large milkweed bug were effective.

Compounds causing less than 75 percent mortality of any species of insect when tested as 10-percent dusts are given in table 5, and those causing less than 75 percent mortality when used as acetone sprays are given in table 6.

http://archive.org/details/propicoa00unit

Of 24 effective compounds tested for phytotoxicity, 2,4,5-trichlorophenyl propionate was the only one that caused moderate to severe injury.
Severe injury resulted to foliage of beans, beets, and corn, and moderate
injury to cabbage. o-Bromophenyl propionate caused slight injury to
radish foliage, and p-bromophenyl propionate caused slight injury to corn
foliage.

Table 1 .- "Effectiveness of three insectioides tested as dusts against various species of insects to be used as standards for comparing results obtained with new compounds

Insect	Insecticidel	Insect	Stage		Feeding	Average percent kill after 2 days
Idd	Percent 1.0	Armyworm do.	Third instar do.	5-4 83	None Moderate Slight	27
Lindane	.125	Large milkweed bug	Fourth instar	tar		100
Parathion	2000	Large milkweed bug Pes aphid do.	Fourth instar Adult Second instar	star	1.1.1	505
	.1	Two-spotted spider mite do.	Nymphs and adults Adults	adults		96

1/ 1 grem dispersed in vacuum duster. 2/ After 1 day.

Table 2.--Effectiveness of three insecticides tested as sprays or dips against various species of insects to be used as standards for comparing results obtained with new compounds

Insecticide	Percent conc In acetone	ooncentration ne In water	Insect	Stage	Average percent kdll after 2 days
DDT	0.05	0 ° 1 ° 8	Armyworm Pea aphid Salt-marsh oaterpillar	Third inster Adult Third inster	9 2 8 6 5 8 5
Lindane	0.	ı	Large milkweed bug	Fourth instar	85
Parathion	00.00.00.00.00.00.00.00.00.00.00.00.00.	.0005	Ar Is	and	93 75 863 802/ 100 100
		.0000	do.	Adults and adults	

1/ Dipped. 2/ After 1 day.

Table 3. -- Propionates causing more than 74 percent mortality of one or more species of insects when tested as sprays or dips

	Percent	Insect	Stage	Feeding	kill l day	kill after- l day 2 days
	In water					
	-	A remuseo ren	Third instar	Moderate	1	0
TOSOT -	4	Large millowed bus	Fourth instar	1	1	70
	4	Pea aphid	Adult	1	1007	1
	ung e	do.	do.	1	46	1
		Two-spotted spider mite	do.	ı	ı	78
	, S	do	do.	1	1	46
	-	A PHILOTOPIA	Third instar	Moderate	1	0
Tongalous	4 -	Large millowed bur	Fourth instar	4	15	64
	1	Pea aphid	Adult	1	10001	
	ro.	do	do.	1	1777	8
		do.	do.	à	391/	1
	1	Two-spotted spider mite	do.	1	ı	78
	. D	do	do.	ı		9
D-Cresol	7	Armyworm	Third instar	Moderate	ı	0
1	1	Large milkwood bug	Fourth instar	8	1	100
	ເດື	do	do.	1	1	22
		Pea aphid	Adult		1001/	8
	ro.	do.	do.	8	/子98	ı
	۲.	do.	do.	ı	761	1
	1	Two-spotted spider mite	do.	£	1	100
	NO.	do.	do.	1	1	9
p-Cresol, alpha-phenyl-		Атпутога	Third instar	Slight	1	100
		Large milloweed bug	Fourth instar	1	1	85
	ı,	do.	do.	1	ı	10

100 100 93 47	87 0 10 100 100 80	100 10 10 7 33	43 13 100 100 141/
747	111111	8 8 8 8 8	57
1111	Slight	None	Slight
Adult do. do. do.	Third instardo. Fourth instardo. do.	Third instardouth instarAdultdo.	Third instar Fourth instar do. do. do.
Pes aphid Two-spotted spider mite do. do.	Armyworm do. Large milkweed bug Pea aphid Two-spotted spider mite do.	Armyworm do. Large milkweed bug Pea aphid Two-spotted spider mite do.	Armyworm Large milkweed bug Pea aphid do. Two-spotted spider mite do.
9 m 0 m m	In acetone 5 7 5 1	5 5 1 1 water	1 1 1 1 ° ° ° ° ° ° ° ° ° ° ° ° ° ° ° °
	o-Cresol, 4-chloro-	o-Cresol, 6-Chloro-	m-Cresol, 4,6-di-tert- butyl-

Table 3. -- (Continued)

ester with	donoentration	Insect		Stage	Feeding	kill a	after-
	In acetone						
p-Cresol. 2-nitro-	2	Armyrorm		Third instar	Slight	1	18
	-	do.		do.	Much	1	0
	Ω (	Large milkweed bug		Fourth instar	1	9	0
	LC)	Pes aphid		Adult	1	3	0
	) LC	Two-spotted spider mite	mite	do.	1	1	100
	, ,	do.		do.	1	8	100
	· 01	do.		do.	ı	ı	100
	۲.	do.		•op	f	1	0
m-Cresol. 6-tert-butyl-		Armyworm		Third instar	None	ı	100
		do.		do.	Much	1	20
	10	Large milkweed bug		Fourth instar	ı	ı	EQ.
	ıo	Pea aphid		Adult	i		21
	ıo.	Two-spotted spider mite	mite	do.	1	1	100
	1	do.		do.	1	1	100
	5	do.		do.	1	8	78
	.1	do.		do.	ı	1	0
p-Cresol. 2-tert-butyl-	-	Armyworm		Third instar	Moderate	1	17
		Large milkweed bug		Fourth instar	1	1	10
	ıs		mi te	Adult	ı	1	86
	ч	do.		do.	ı	1	0
Cvolohexaneethanol	ш	Armyworm		Third im tar	None	1	100
	7	do.		do.	Much	1	0
	10	Large milkweed bug		Fourth instar	1	1	10
	10	Pea aphid		Adult	1	1	17
	NO.	Two-spotted spider mite	mite	do.	1	1	100
	7	do.		do.	1	ı	83
				- 7	1	1	00

	7	0,0	7001	8		53		47	17	0	70	100	88	28	B**	40	വ	100	45	100	99	42	0	0	94	43	93	2	19	100	
	1	1		817	2777	1		1		1	1	- 1	8					1	1	-		1	1	ı		1	1	ı	,		
	Moderate	1	ı	8	1	148 -		Madawata	monera ce		1	1	1	ı	1000000	monera ce	1	1	1	8	1	Moderate	1	1	,	ı	None	1	1	ı	
	Third instar	Fourth instar	Adult	do.	do.	Nymphs and adults		Whited trates	THE THE COL	Fourth instar	Adult	do.	do.	do.	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	דוודו מ דווף המז	Fourth instar	Adult	do.	do.	do.	Third instar	Fourth instar	Adult	do.	op.	Third ins tar	Fourth instar	Adult	do.	
	Armyworm	Large milkweed bug	Pea aphid	do	do.	Two-spotted spider mite		A service Park A Service	ALTINO WOLID	Large milkweed bug	Pea aphid	Two-spotted spider mite	do	do。	Cope CARA Avena	SELILLY WOLLIE	Large milkweed bug	Pea aphid	do.	Two-spotted spider mite	do.	Armyworm	Large milkweed bug	Pea aphid	Two-spotted spider mite	do.	Armyworm	Large milkweed bug	Pea aphid	Two-spotted spider mite	
In water	Cyclohexanol		~	ហ្វ	۲.		In acetone	A _ lared o loure of lower of love	o description of the section of the	a	EQ.	es.		υ. Co.	Carloherence A-care	T CONTO TO SO T	വ	മ		co.	П	Cyclohexanol, 2-isopropyl- 5	so.	S	5	H	Cyclohexanol, 4-isopropyl- 5	10	5	co.	

1/ Dipped.

Table 5 .-- (Continued)

ester with	Percent concentration	Insect	Stage	Feeding	kill l day	Average percent kill after l day 2 days
	In acetone					
Cyclohexanol, 2-phenyl-	9	Armyworm	Third instar	Slight	1	83
	п	do.	do.	Much	ı	0
	2	Large milkweed bug	Fourth instar	,	1	0
	2	Pea aphid	Adult	ı	0	1
	2	Two-spotted spider mite	do.	1	1	100
	1		do.	1	1	100
	.5	• op	• op	1	ı	46
Cyclohexanol, 2-sec-butyl-	2	Аттумота	Third instar	Mode rate	1	80
	7	do.	do.	Much		0
	2	Large milkweed bug	Fourth instar	1	ı	0
	2	Pea aphid	Adult	1	ŧ	13
	2	Two-spotted spider mite	do.	1	1	100
	1	do.	do.	ı	1	0
Cyclohexanol, 4-880-butyl-	2	Агтумога	Third instar	None	ı	100
	7	do.	do.	Much	1	0
	S	Large milkweed bug	Fourth instar	1	1	160 ml
	9	Pea aphid	Adult	1	ı	03
	Ω	Two-spotted spider mite	do.	1	1	100
	7	do.	· op	1	ı	45
Ethanol, 2 phenoxy -	S	Armyworm	Third instar	Moderate	í	17
	5	Large milkweed bug	Fourth instar	1	1	20
	2	Pea aphid	Adult	1	1	17
	LQ.	Two-spotted spider mite	do.	ı	8	100
	Н	do.	do.		1	28
Ethanol, 2-(p-tert-	S	Атпучотп	Third instar	Much	1	0
butylphenoxy)	2	Large milkweed bug	Fourth instar	1	ı	0

94 95 29 100 100 44	90 <b>1</b> 00 00 00 00 00 00 00 00 00 00 00 00 00	52 5 100 100 100 <b>8</b>	60 0 83 14 100 100 100 1	35
	1 1 4 1 1	1110111	145	t
1 1 1 1 1 1	Moderate	Moderate	Slight	1ts -
Adult do. do. do. do.	Third instar Fourth instar Adult do.	Third instar Fourth instar do. do. do.	Third instar Adult do. do. Third instar Fourth instar do. do.	Nymphs and adults
Pea aphid do. do. Two-spotted spider mite do.	Arnyworm Large milkweed bug Pea aphid Two-spotted spider mite do.	Armyworm Large milkweed bug Pea aphid Two-spotted spider mite do. do.	Armyworm Large milkweed bug Pea aphid Two-spotted spider mite do. Armyworm Large milkweed bug Pea aphid do. do.	Two-spotted spider mite
ا تو <mark>تو در </mark>	٦٥٤٤	5 5 1 .5 .1	1111 111 0 111	٦
	1-Menthol	1-Naphthol	1-Naphthol, 2,4-dichloro-	

2 days Average percent kill after-1000 861 471 541 95 45 100 100 100 l day 577 1001 ı ı Moderate Feeding Slight ı Much None Fourth instar Fourth instar Fourth instar Chird 11.8 tar Third instar Third instar Third instar Stage do. Adult do. do. 90° op op Adult do. do. do. op. · op do. do. · op do. Adult do. Adult Two-spotted spider mite Two-spotted spider mite Two-spotted spider mite Salt-rarsh caterillar Large milkweed bug Large milkweed bug Large milkweed bug Insect Pea aphid Pos aphid Pea aphid Armywo rm Armywo re. A racywo ren op. do. do. do. do. do. do. 000 do. do. do. oonoentration Percent In water 500 () • cu • . -Phenol, 2-bromo-4-phenyl-Phonol, p-(alpha, alpha-dimethylbenryl)-Phenol, 2-bromo-4-tert-Proplonic acid ester with butyl-

Table 3. -- (Continued)

50 92 100 58	10 85 20 1001/	0 5 12 100 65	87 0 0 100 100 37
1110011	841/	1 1 1 1 1	1 1 1 20 1 1 1 1
Moderate	Moderate	Much	Slight Much
Third instar Moreouth instar Adult do. Nymphs and adults do.	Third instar Mo Fourth instar do. do. do. Nymphs and adults do.	Third instar Fourth instar Adult do.	Third instardouth instarAdult do. do. do. do.
Armyworm Large milkweed bug Pea aphid do. Two-spotted spider mite do.	Armyworm Large milkweed bug do. Pea aphid do. Two-spotted spider mite do.	Armyworm Large milkweed bug Pea aphid Two-spotted spider mite do.	Armyworm do. Large milkweed bug Pea aphid Two-spotted spider mite do. do.
מ מ	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	In acetone 5 5 5 5 5 5 1 1 1 1 1 1 1 1 1 1 1 1 1	רט מטטרט
Phenol, o-bromo-	Phenol, p-bromo-	Phenol, p, p'-2-butylidene-di-(dipropionate)	Phenol, 2-chloro-4-phenyl-

Taile 3. -- (Continued)

Proplonic acid	Percent	Insect	Stage	Feeding	Average percent kill after- l day 2 days	kill arter-
	In water					
French o-coloro-	7	Amyworm.	Third instar	Moderate	,	0
1	_	Large milkweed bug	Fourth instar	1	1	45
	7	Pes aphid	Adult	1	1	106
		do.	do.	ı	1001/	ı
	.1	do.	do.	1	247	i
	_	Two-spotted spider mite	Nymphs and adults	ults -	1	70
	• 5	do.	do.	1	1	53
inearly perilone-	~-1	ATTIONS	Third instar	Moderate	ı	0
	_	Large milkweed bug	Fourth instar	1	1	08
	· 0	do.	do.	1	ı	50,
	7	Pou aphid	Adult	ß	1	841
	• 22	do.	do.	1	1007	1
	•1	, op	do.	8	201/	1
	7	Two-spotted spider mite	Nymphs and adults	ults -	1	96
	9.	do.	do.	•	1	83
	۲.	do.	· op	ı	2	0
Phenol, o-cyclonexyl-	7	Аттумот	Third instar	Slight	- 1	73
1	· .	do.	do.	Moderate	1	90
	7	Large milkweed bug	Fourth instar	1	1	8
	9.	do.	do.	ı	ı	85
	٦.	do.	do.	ŧ	8	0
	~	Pea aphid	Adult	i	7.1	8
	7	Two-spotted spider mite	· op	i	1	100
	• 22	do.	· op	1	ı	100
		90	90	1		1.4

8	0	86	- 100	- 94	76	39	10	0	33	- 100	- 100	- 85	- 65		13	- 80	85	0	58	- 100	- 79.	762 -		- 100	- 97	1		
Moderate	8	•	8	1			Much	1	1	8	8	9	1		Slight	8	8	•	8	1	8	1		Slight	do.	Moderate	op op	
Third instar	Fourth instar	Adult	do.	do.	do.	do.	Third inster	Fourth instar	Adult	do.	do.	do.	do.		Third instar	Fourth instar	do.	- op	Adult	do.	do.	qo•		Third instar	do.	do.	do.	
Armyworm	Large milkweed bug	Pea aphid	Two-spotted spider mite	do.	do.	do.	Armyworm	Large milkweed bug	Pea aphid	Two-spotted spider mite	do.	do.	do.		Armyworm	Large milkweed bug	do.	do.	Pea aphid	Two-spotted spider mite	do.	do.		Armyworm	do.	do.	do.	
a	വ	2	ຄ	rl	• 5	۲.	ເລ	2	വ	വ	٢	េំ	.1	In water	Н	٦	ស្	۲.	-	Н	ខ្មុ	.1	In acetons	S		ស	1.	
Phenol, 2,6-dibromo-4-	tert-butyl-						Phenol, 2,4-dichloro-6-	phenyl-							Phenol, 2,4-dichloro-									Phenol, 2,4-dinitro-6-	pheny1-			

In acetone

\_\_\_\_ 3. -- (Continue 1)

Proplonic acid	Percent	. sect	Stage	Fooding	Averaçe kill a	Alter-
	In acetone					
P. 1920], 2,4-1201-10-5-	rc.	Pea aphid	Adult	ı	9	804
(penu, impo)-[Ameno	_		· C	å	ı	44
	(1)	Two-spotted spider mite	do.	ı	î	100
	_		do.	1	1	100
	.5	do.	do.	1	ı	40
	7.	do.	do.	ı	ı	100
	0.05	do	0,00	l	ı	96
	.01	do.	do.	t	ı	63
inenil, 2,4-4,-tert-butyl-	ıc	Arnyworm	Third instar	Sign	8	87
6-180000	ניז	Large milkweed bug	Fourth instar	ł	1	40
	52	Pea aphid	A (2, 12)	ı	0	ı
	1	Two-spotted solder mite	· op	2	1	0
Phenol, m-etryl-	ß	Атпумотш	Third Instar	Sli,-it	1	50
-	1	do.	do.	Much	í	2
	2	Large milkwood bug	Fourth nater	ı	ı	2
	5	Pea aphid	Adult	ı	0	\$
	7	I'w - stotted syider mite	· op	3	8	3
Phonol, o-isopropyl-	20	A MAINTH I MA	Third instar	None	ÿ	100
	1	do.	do.	Munit	1	0
	2	Large milkwood bug	Fourth instar	1	0	0
	2	Pea aphid	Adult	ŧ	1	25
	9	Two-spotted spider mitte	do.		i	100
	~		do.	1	9	100
	· .	do.	· op	t	1	200
Passal, p-langeonyl-	~	A range or is some	Third instar	Missell	1	113
	2	Large milkwood bug	The state of the s		8	2

		<b>*</b> 17 -		
95	60 13 40 100 40 21	90 100 100 62	100 97 23 0 0 100 100 100 93	1000 1000
1 1		1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1	1 1 1 1
	Slight Moderate	Slight Much	Slight do. Moderate  Much	None do. do.
Adult do.	Third instar Sl. do. Fourth instar Adult Nymphs and adults do.	Third instar do. Fourth instar do. do. do.	Third instardo.  do. Fourth instar Adult Adult do. do. do.	Third instardo.
Two-spotted spider mite do.	Armyworm do. Large milkweed bug Pea aphid Two-spotted spider mite do.	Armyworm do. Large milkweed bug Fea aphid Two-spotted spider mite do. do.	Armyworm do. do. Large milkweed bug Pea aphid Salt-marsh oaterpillar Two-spotted spider mite do. do. do.	Armyworm do.
e e	In water  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	In acetone 5 5 5 7 .5 .5	1 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	8 T
	Phenol, o-nitro-	Phenol, p-nonyl-	Phenol, pentabromo-	Phenol, pentachloro-

Propionic acid	Percent	Invest	⊕ 12 B 22	Faeding	Avoraço percent kill after- l day 2 days	fter- 2 days
	In acetone					
		Large Total Sead Live	Fourth instar	2	1	10
(continued)	Го	Pea aphid	Adult	1	0	8
	LO	Two-spotted spider mite	do.	8		100
	·	do.	do.	8	9	100
	5.	000	do.	ı	1	100
	000	do	do.	1	8	<b>₩</b>
	.01	do.	op.	ı	ı	18
	-9	世上の単なことが	Third instar	None	1	100
			do.	Much		873
	ເລ	Large milkweed bug	Fourth instar	ÿ	1	142)
	· (C)	Pes sphid	Adult	8	0	8
	) <b>L</b> O	Two-spotted spider mite	do	ı		188
			do.	1		100
	50	do.	do.	ł	ı	100
	.1	do.	do.	1	8	200
1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	- 9	A remit A remit	Third instar	Moderate	1	6.3
	(0)	Large milkwood bug	Fourth instar	a	8	0
	vo	Pos sphid	Adult	8	8	17
	140	Two-spotted spider Bite	do.	1	8	100
	-	000	do.	1		100
	50.	do.	do.	i	8	47
	In wa. or					
Progot 4-tertal		Arryword	Third instar	None	8	100
2-ohloro-	9.	do.	do.	Much	1	0
	1	LATE, o The KNOO! DAG	Fourth instar	1		80
	1	Pea aphid	Adult	1	188	
		do	dos	8	107/	8

(4519 3.-- (C.E. 241.1)

20013	1000110000	100 100 100 100 100 100 45 45
3 8 8 8	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	8 8 8 8 8 8 8 8 8 8 8
Much	None Much Much	None Slight Much Moderate
Third instar Adult do.	Third instar do. do. do. Adult do. Third instar Adult do. do.	Third instar do. Fourth instar do. Adult Third instar do. do. do.
Salt-marsh caterpillar Two-spotted spider mite do.	Armyworm do. Large milkweed bug do. do. Salt-marsh caterpillar Two-spotted spider mite do. do.	Armyworm do. do. Large milkweed bug do. Pea aphid Salt-marsh caterpillar Two-spotted spider mite do. do. do.
ਨੂਰ ਰਿਜ	In acetone	
	Phenol, p-tert-butyl-	Phenol, 2,3,4,6-tetra-chloro-

fter- 2 days	26 100 100 21 21	100 255 1000 1000 100 100	13 30 1001/ 100 100 100 36
Average percent kill after- l days 2 days	111111	1001	527
Feeding	Slight	None Moderate Moderate	Slight
S. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2.	Third instar Fourth instar Adult do. do. do.	Third instar Now do.  Adult do. Third instar Mod Nymphs and adults do. do. Third instar Mod do. do. do.	Third instar Fourth instar Adult do. do. Nymphs and adults- do.
Tuned	Large milkweed bug Pea aphid do. do.	do.  Two-spotted spider mite do.  do.  do.  do.  do.  do.	Armyworm Large milkweed bug Pea aphid do. do. Two-spotted spider mite do.
Percent	In acctone	In water  1 . 6  1 . 6  1 . 7	L L L L L L L L L L L L L L L L L L L
Stroy Loude media	Please, 2,1,8-enflarment	Thereto, 414,5-1704/days	Phenol, 2,4,6-triorloro-

0	10	8	8	27
1	8	1001	69	1
Moderate	1		1	
Third instar Moderate	Fourth instar	Adult	• op	qo•
Armyworm	Large milkweed bug	Pea aphid	do	Two-spotted spider mite
el	groot)		rů.	
(dipropionate)	1			
Prrocetachol				

1/ Dipped.

Table 4. -- Propintates causing more than 74 percent merteling of one or nore spenies of onesons when tested as dusts

		Ingeot	Stage	Feeding	kill k	after-
פתרפת אזרט			,		1 day	2 day.
	Percent					
Seniornemone. 2.4'-d1-	10	Armyworm	Third instar Much	car Much	t	9
hydroxy- (dipronienate)		Celery leaf tier	do.	None	1	200
•		Large milkweed bug	Fourth ing	instar -	I	0
		Pea aphid	Adult	1	0	1
		Two-spotted spider mite	eo do.	ı	ŧ	0
Fent of herone, 4,4 1-diny-						
droxy-(dipropionate)	10	Arranorm	Third ing	Third instar Moderate	ŧ	7
4		Celery leaf tier	do.	Slight	1	30
		Large milkweed bug	Fourth instar	tar -	8	0
		Pea aphid	Adult	8	0	
		Two-spected spider mite	to do.	8	1	5
m-Cresol, 6-tert-butyl-	10	Armyworm	Third inst	Third instar Moderate	1	62
		Large milkweed bug	Fourth in	inster -		D
		Pea aphid	Adult	•	0	
		Two-spotted spider mite	te do.	1	1	J. 20
1,5-Naphthalenediol	10	Armyworm	Third inst	instar Moderate	1	0
(digre; longto)		Colory leaf tier	• op		6	75
		Large milkweed bug	Fourth in	instar -	1	C
		Pea aphid	Adult	1	0	0
		Two-spotted spider mite	to do.	8	1	O
2-Naphthol	10	Агазунота	Third inst	Third instar Moderate	4	0
		Large milkweed bug	Fourth instar	star -	\$	0
		Pea aphid	Second in	instar -	100	
	W)	do	Adult		200	0

Phenol. 2-bromo-4-	10	Armyworm	Third instar	Moderate	1	13
tert-butyl-		Colory leaf tier	do.	None	8	100
		Large miliweed bug	Fourth instar	•	•	10
		Pea aphid	Adult		0	1
		Two-spotted spider mite	do.	ı	1	ঝ
Phenol. p-cyclohexyl-	10	Armywoma	Third instar	Moderate	8	0
		Celery leaf tier	do.	Slight	9	92
A		Large milkweed bug	Fourth instar		i	0
re		Pea aphid	Adult	ı	0	8
LIE L P		Two-spetted spider mite	do.	1		4
- Atherm Consultation of the Atherna	10	Arnyworn	Third instar	Moderate	8	0
ARN	1	Celery leaf tier	do.	Slight	8	100
r I		Large milimeed bug	Fourth instar	1	1	ເລ
BC		Pea aphid	Adult	1	0	0
)AI		Two-spotted spider mite	do.	1	3	0
Phenol. p-ethyl-	10	A rraywo rm	Third instar	Much	1	0
		Celery leaf tier	do.	Slight	1	3
		Large milkweed bug	Fourth instar	ŧ	•	0
		Pea aphid	Adult	1	0	â
		Two-spotted spider mite	•op	3	8	0
Phenol. p-nftro-	10	AITHUWOITH	Third instar	Moderate	dib.	10
4		Large milkweed bug	Fourth instar	0	9	10
		Pea aphid	Second instar	c con	100	2
	Ω.	do.	Adult	0	79	ê
	7	do	do.	0	41	9
	00	Two = snot tod enider mite	Numbe and adults =	1+0	477	7.0 FU

1/1 gram dispersed in vacuum dusmr.

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Proplonic acid		108000	Stare	Buipee	Average kill l day	Average percent kill after- l day 2 days
	Persent	at.				
Famini, pentaghloro-	0)	Armyworm Large milloweed bug	Third instar	None	1 0	100
		rea aphid Two-spotted spider mite	Adult do.	8 6	09	100
- Men - C 1 1 1 1 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1	10	THE PART LAND	This instar	Much	1	ĸ
		Large milkweed bug	Fourth instar	1	ı	0
		Pos aphid	Adult	â	0	8
		Two-spotted spider mite	do.	f	6	100
Francis 2, 2, 4, 8-	3.0	Arragaore	Taird instar	None	1	100
. erracinomie,		Lurie millored bug	Fourtz instar	ı	ı	വ
		Pea aphid	Adult	1	19	8
		Two-spotted spider mite	do.	8	3	100

1 gram dispersed in vacuum duster.

Table 5.--Propionates causing less than 75 percent mortality of any species of insect when tested as 10-percent dusts

Propionic acid	Inscot	Stage	Feeding	Average kill l day	Average percent kill after- l day   2 days
m-Cresol, 6-anyl-	Armyworm Celery leaf tier do. Large milkweed bug Fourth Pea aphid Two-spotted spider mite do.	Third instardo. Fourth instarAdult ite do.	Moderate do.	11101	4 ac o
p-Cresol, 2-nitro-	Armyworm Large milkweed bug Fourti Pea aphid Two-spotted spider mite do.	Third instar Fourth instar Adult	Moderate	1 101	00 0
o-Cresol, 4-tert-butyl-	Armyworna Celery leaf tier Large milkweed bug Pea aphid Two-spotted spider mite	Third instar do. Fourth instar Adult ite do.	Moderate do.	8 8 8 0 8	10 00 0 O
p-Cresol, 2-tert-butyl-	Armyworm Celery leaf tier do. Large milkweed bug Fourt Pea aphid Two-spotted spider mite do.	Third instar do. Fourth instar Adult ite do.	Moderate do.	: : : • :	0410
Syclehexaneethanol	Armyworm Pea aphid	Third instar	Moderate	10	0

1/1 gram dispersed in vacuum duster.

Proplemic acid	20 mm	Stage	Feeding	Average percel kill after- l day   2 da	Average percent kill after- l day   2 days
Cycloherend, 2-180- propyl-	A right of and a	Third instar	Moderate	10	0
Sycloperation, s-lac-	Pos aphid	Third instar	Moderate	10	0
Cyclohexanol, 2-phenyl-	Lerre milbreed bug Pea aphid Two-spotted spider mite	Thurst inster Fourth inster Adult	Moderate	1101	0000
butyl-	Pea aphid	Adult	ì	0	0
Suspension i	Actions less tier large mirward bur Pea aphid Two-spotted spider m	Third Heter do. Febrush Estar Adult mite do.	Much Moderne	11101	080 6
G 155 (80 - 2)	Armysons. Colory leaf tior Large milkweed bug Pea aphid Two-spotted spider m	tior do.  to bug Fourth instar  apider mite do.	M Merate do.	11101	0 0 0 0
Rydrogula co (diprogles to)	Celery leaf tier Large milkweed bug Pea aphid Two-spotted spider mite	Third instar do. Fourth instar Adult	Moderna, o	1 1 1 0 1	004 9

1-Menthol	Armyworm Celery leaf tier Large milkweed bug Pea aphid Two-spotted spider mite	Third instardo. Fourth instardult	Moderate do.	11101	0 0 0
1-Naphthol	Armyworn Large milkweed bug Peg aphid Two-spetted spider mite	Third instar Fourth instar Adult do.	Moderate -	1 1 1 1	00 6
Phenol, 2-chloro-4- phenyl-	Armyworm Large milkweed bug Pea aphid Two-spotted spider mite	Third instar Fourth instar Adult do.	Moderate	1101	00 8
Phenol, o-isopropyl-	Armyworm Pea aphid	Third instar Adult	Modera te	10	0
Phenol, p-isopropyl-	Armyworm Celery leaf tier Large milkweed bug Pea aphid Two-spotted spider mite	Third instardo.  Go. Fourth instarAdult	Moderate do.	11101	0 8 0 0
Phenol, p-methoxy-	Armyworm Celery leaf tier Large milkweed bug Pea aphid Two-spotted spider mite	Third instardo. Fourth instardult	Much Moderate	11101	10 10 30
Phenol, p-nonyl-	Armyworm Pea aphid	Third instar Adult	Moderate	10	10

1/1 gram dispersed in vacuum duster.

Table 0,--(Combinued

Proplomic acid	Colmot	Stage	Foeding	1 049	Aven reat
Themol, p-phenyl-	Amirworm Large milkweed bug Pea aphid	Third instar Fourth instar Adult	Much	1(4)	30   2
Phonol, 2,4-di-tert-	Armyworm Celery leaf tier Large milkweed bug Pea aphid Two-spotted spider mite	Third instar do. Fourth instar Adult do.	Moderate do.	11/01	10 to 0
Phenol, 2-tert-butyl-	Lerge milkweed bug Pen aphid	Third instar do. Fourth instar	Moderate do.	1 7 7 6 8	10 10

1/ 1 gram dispersed in vacuum duster.

Table 6. -- Propionates causing less than 75 percent mortality of any species of insect when used as acetone sprays

Propionic acid ester with	Percent concentration	Insect	Stage	Feeding	Average kill l day	Average percent kill after-
Benzophenone, 2,4'-dihy-droxy-(dipropionate)	1 2	Armyworm Large milkweed bug Pea aphid Two-spotted spider mite	Third instar Fourth instar Adult	Much	1101	0916
Benzophenone, 4,4'-dihy-droxy-(dipropionate)	2	Armyworm Large milkweed bug Pea aphid Two-spotted spider mite	Third instar Fourth instar Adult do.	Much	1 1 0 1	0010
m-Cresol, 6-amyl-	1 2 1	Armyworm Large milkweed bug Pea aphid Two-spotted spider mite	Third instar Fourth instar Adult do.	Much	1101	100
o-Cresol, 4-tert-butyl-	1 2 1	Armyworm Large milkweed bug Pea aphid Two-spotted spider mite	Third instar Fourth instar Adult do.	Much	1101	10 10 O
Eugenol	7 27	Armyworm Large milkweed bug Pea aphid Two-spotted spider mite	Third instar Fourth instar Adult do.	Much	1101	0010

Table 8, -- (Continued)

Propionic acid	Percent	Insect	Stage	Feeding	Average kill s l day	percent after- 2 days
Guslacol	ما	Armyworm Large milkweed bug Pea aphid Two-spotted spider mite	Third instar Fourth instar Adult do.	Much	1101	13
Hydroquinone (dipropionate)	a	Armyworm Large milkweed bug Pea aphid Two-spotted spider mite	Third instar Fourth instar Adult do.	Much	1101	50 ° 0
1,5-Naphthalenediol, (dipropionate)	ш	Armyworm Large milkweed bug Pes aphid Two-spotted spider mite	Third instar Fourth instar Adult do.	Moderate	1101	00 1 4
Phenol, p-cyclohexyl-	7 2	Armyworm Large milkweed bug Pea aphid Two-spotted spider mite	Third instar Fourth instar Adult do.	Much	1 1 23 1	38
Phenol, p-ethyl-	7 2 7	Armyworm Large milkweed bug Pea aphid Two-spotted spider mite	Third instar Fourth instar Adult do.	Much	1 10,1	0,0
Phenol, p-methoxy-	1 2	Armyworm Large milkweed bug Pea aphid Two-spotted spider mite	Third instar Fourth instar Adult do.	Much	1101	1010

0 0	0 0 42
1101	1 1 9 1
Much	Moderate
Third instar Fourth instar Adult	Third instar Fourth instar Adult do.
Armyworm Large milkweed bug Pea aphid Two-spotted spider mite	Armyworm Large milkweed bug Pea aphid Two-spotted spider mite
H 61 H	In water
Phenol, 2-tert-butyl- 6-isopropyl-	Hydroquinone, 2,5-di-tert- butyl-(dipropionate)

